

NATURE AND EXTENT OF DAMAGE TO COCONUT
AS A RESULT OF FEEDING BY *STEPHANITIS TYPICUS*
(DISTANT) (HETEROPTERA : TINGIDAE)

K. MATHEN, M. P. GOVINDANKUTTY AND CHACKO MATHEW
*Central Plantation Crops Research Institute, Regional Station,
Kayangulam, Krishnapuram 690 533, India.*

ABSTRACT

The lacebug *Stephanitis typicus* (Distant), a minor pest of coconut foliage, assumes importance because of its reported role as vector of Coconut Root (wilt) disease. Inoculation of palms in the field and of seedlings under insect proof green house conditions had brought about transmission of the disease. The nature and extent of damage to coconut pinnae are discussed here on the basis of feeding marks, histology and chlorophyll content analysis.

Both adults and larvae of all stages feed from the lower surface of coconut pinnae, leaving permanent chlorotic spots on the adaxial surface. These yellow scars vary from small pinpricks to large coalesced patches with an average area of 0.112 mm² under laboratory conditions. The mean number of feeding marks produced by one adult in 24 h was 80. An average area of 8.96 mm² is therefore dechlorophylled by a single insect per day. With an average count of 490 adults on the crown of a palm, the total area rendered unsuitable for photosynthesis is 4390 mm²/day. The removal of chlorophyll per adult per day is to the tune of 0.24 µg. per gram fresh weight or 0.078 µg./cm² of leaf. Not only the chlorophyll, but the entire cell contents are drained while feeding; the palisade cells appear to be depleted. A stylet sheath is not made out and evidence of a prominent role of saliva during feeding is little.

INTRODUCTION

Stephanitis typicus (Distant) has been reported as a foliar pest of 16 different plants belonging to 13 genera under 8 families. On coconut, it is recorded from Singapore (Anonymous, 1915), India (Fletcher, 1917; Nirula, 1955; Mathen 1960) and Malaya (Corbett, 1932). Its role as a pest has however been considered only as of minor importance. Nevertheless, the reported role of the tingid bug in transmitting Coconut Root (wilt) disease in South India

(Nagaraj and Menon, 1955; Shanta *et al.*, 1958), rendered the insect as one of significant concern in coconut cultivation. An attempt was therefore made to study the nature and extent of damage caused to coconut due to its feeding and the results are reported here.

MATERIALS AND METHODS

Studies on general aspects of insect feeding on coconut leaflets were carried out in laboratory cages in which adults and nymphs were established on coconut leaflets with their bases along with a small portion of the rachis dipping in water held in glass bottles. Details of feeding were observed with the insect(s) liberated into test tubes holding about 15 cm length of longitudinal halves of leaflets split along their mid ribs, with the bases of leaflets kept moist by water-soaked cotton plugs. Procedure on estimation of chlorophyll and the method of histological preparations are described under the respective sections.

RESULTS AND DISCUSSION

General observations on feeding

Feeding by the insect produces permanent dechlorophyllated marks on the upper surface of coconut leaflets. Both adults and young ones of all stages feed on the lower surface of the leaflet. This was ensured by a simple experiment in which the insects were liberated into glass tubes containing segments of leaflets with either of the two sides masked with paper. Observation after 24 h showed that feeding marks were present on the adaxial (upper) surface of the leaflets only when the abaxial (lower) surface was available to the insect for feeding. Feeding marks did not appear either on the upper or lower surface when the latter was covered. Young ones exhibit congregational habits, more pronounced up to the third instar nymph stage. The number of nymphs in the various groups is, however, variable. While feeding, the rostrum is kept nearly at right angle to the body of the bug, which remains parallel to the leaflet lamina by a firm hold with all the legs. After the

insect selects the feeding site, it feeds at a spot for 10 to 30 minutes. No visible evidence of stylet insertion is left in the feeding surface. When the feeding marks are very close, they coalesce to form yellow blotches. Observations at intervals of 30 minutes revealed that a feeding mark made its appearance visibly clear on the upper surface of leaflet to two at two and a half hours after the insertion of the stylet on the lower surface. When male and female bugs were caged either singly or in combinations of male(s) and female(s) for a total of 4 bugs, the mean number (average of ten counts in each case) of feeding marks produced by a single insect in 24 h ranged between 61 and 104.3 giving a weighted average of 80 feeding marks per insect per day. The area covered by the feeding scars was also found to vary from pinpricks to small dots. Mean of five values, each representing the average area of ten representative feeding scars produced by a single insect in 24 h was 0.112 mm^2 (the area of each feeding scar was calculated by multiplying the highest length with the smallest width; the smallest scar measured 0.0032 mm^2 and the largest 0.612 mm^2). Thus on an average, one adult dechlorophylled 8.96 or 9 mm^2 leaf area in a day.

Estimation of chlorophyll depletion

Coconut leaflets with about 30 cm length from their tips cut and removed, were split into two along the midrib from the cut end, for about 20 cm. One of the split halves was introduced into a glass tube into which 50 adults from a single lot of insects collected from coconut seedlings were previously liberated. The tube was then firmly plugged with cotton. The other half of the leaflet was introduced into a similar but empty tube and plugged likewise. Bases of the leaflets were kept dipped in water in glass bottles. After 24 h the leaflets were taken out and 10 cm length of the fed portion was cut and weighed. An equal length of the corresponding normal half of the leaflet was also cut and its weight recorded. The area of the fed and normal leaflet pieces was separately noted. Leaf chlorophyll was extracted in acetone and estimated by the method described in AOAC (1966). The total chlorophyll

content was calculated from absorption data using the equations of Comar and Zscheile (1942). The results of seven replications are summarised in Table 1.

Table 1. Total chlorophyll content of coconut leaflet fed by *S. typicus* in comparison with normal leaflet.

S. No.	Normal leaf	On weight basis (Expressed as $\mu\text{g/g}$ fresh weight)		Normal leaf	On area basis (Expressed as $\mu\text{g/sq. mm}$)	
		damaged leaf	difference		damaged leaf	difference
1	1.78	1.68	0.10	0.455	0.428	0.027
2	1.85	1.75	0.10	0.483	0.469	0.014
3	1.85	1.78	0.07	0.486	0.453	0.033
4	1.83	1.75	0.08	0.514	0.471	0.043
5	1.85	1.64	0.21	0.496	0.443	0.053
6	1.66	1.57	0.09	0.479	0.430	0.049
7	1.84	1.65	0.19	0.493	0.438	0.055
Total	12.66	11.82	0.84	3.406	3.132	0.274
Mean	1.81	1.69	0.12	0.487	0.448	0.039

Statistical analysis	Mean weight of chlorophyll	
	(weight basis)	(area basis)
normal leaflet	1.81	0.487
damaged (fed) leaflet	1.69	0.448
difference	0.12	0.039
t - value	5.67**	6.917**

**Significant at $P = 0.01$

In terms of total chlorophyll consumed, 50 insects, on an average reduced 0.096 mg chlorophyll as a result of their feeding during 24 h (average weight of leaflet segments : 0.7956 g multiplied by mean difference in weight of chlorophyll between normal and damaged leaf : 0.12 mg/g). In a count of the total population (actual) of the insect on palms at the

Research Institute farm, there was an average of 490 adults per palm (mean of ten counts with ten palms in each count). They would therefore remove $(0.096 \times 490/50 = 0.94)$ 1 mg chlorophyll per day from an average total area of 4390 mm^2 (490×8.96). When the pest occurs in greater numbers during its peak periods of abundance on the crown of palms the loss would be greater. If the chlorophyll removal by the nymphs also is taken into consideration, the damage caused is quite serious. Moreover, the insects feed not exclusively on the chlorophyll, but sucks the entire cell contents, of which, chlorophyll forms only a certain percentage. Chlorotic spots can hinder normal photosynthetic process.

Histological studies

Epidermal peelings - The upper and lower epidermis of fed and normal leaf segments were separated out by boiling them for 10 minutes in a solution of 2% potassium chlorate in nitric acid (1:4 w/v). The cleared epidermal peelings were stained with 1% safranin and examined under a compound microscope at a magnification of 40×15 . No punctures on lower epidermal cells could be detected.

Transections of pinnae - Coconut leaflets, normal and damaged as a result of feeding by *S. typicus* were fixed in formalin-acetic-alcohol, dehydrated and infiltrated through tertiary butanol-paraffin. Paraffin embedded materials were cut at 10μ thickness with a rotary microtome and stained in safranin-fast green combination according to Johansen (1940).

Internal damage is indicated by a sparse distribution of chloroplasts in the component cells of the palisade in the leaflet fed by the insect. These cells stain less intensely than the cells of the normal leaflet and appear to have been emptied by the insect. But these cells retained their shape. Immediately inner to the lower epidermis, small cavities were noticed. They are formed probably by the rupture of the cell walls as a result of intracellular penetration of the stylets. Also no salivary sheath was made out.

The observation reported here on the production of permanent yellow scars on the upper surface of pinnae with no visible evidence of stylet insertion on the feeding surface is in agreement with that reported by Johnson (1937), on rhododendron leaves by the tingid bug *Stephanitis rhododendri* H. He found that a fairly typical feeding mark made by an adult feeding for 13 minutes on a leaf of 'Ascot Brilliant' measured 0.5×0.111 mm; on coconut, the feeding marks left by *S. typicus* in 24 h by a single insect measured on an average, 0.112 mm². Internal damage effected in the form of emptying of palisade tissue is similar to damage in rhododendron leaf (Johnson, 1937) and eggplant leaf (Pollard, 1959) by *Urentius aegyptiacus* B. Entry of stylet through stomata has been demonstrated in both these cases, intercellular penetration therefore probably accounts for absence of any mark on the feeding surface. Although the role played by saliva during feeding has been well brought out in the case of several bugs (Miles, 1959, 1967, 1978; Flemin *et al.*, 1954; Hori, 1973; Nair and Mohandas, 1962), role of saliva in the case of feeding by tingids does not seem to be prominent as suggested by Johnson (1937) and as it is observed in the present study. The polyphagous habit of the bug which is rather an exception in the group of Tingidae is significant in the reported role of the insect in transmitting Coconut Root (wilt) disease. Acquisition of inoculum from alternate hosts has to be taken care of in transmission trials on the main host on the one hand, while on the other, it also offers the possibility of an inoculum-free population of insects being maintained on other food plants. Efforts to control the insect on coconut for the sake of controlling the disease it transmits will naturally have to be extended to all other reported food plants also. As a pest *S. typicus* does not seem to be important enough to be considered as very serious since it is not able to inflict appreciable damage to the crop through its feeding, like death of plants or drying/drooping/curling/withering of leaves reported in other cases of tingid infestation on other plants. The kind of damage to coconut caused by the bug is permanent discolouration of the area from where the plant sap is

sucked up and injury to leaf surface through breeding (egg-laying, eclosion) and deposit of faecal matter, interfering with normal photosynthesis and gaseous exchanges besides damage done to internal tissue. Even the peak abundance of the bug population appears to be tolerated by the coconut palm. Nevertheless the reported role of the insect as vector transmitting Coconut Root (wilt) disease is sufficient to arouse concern about the need for devising control measures. Joseph *et al* (1972) reported that although a single insect could transmit the disease, effective transmission was brought about by groups of ten insects and that sixteen per cent of the field population was effective.

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